Stand ALone Missions of Opportunity Notice (SALMON)
Program Element Appendices (PEA) H2 and H5
Preproposal Conference
Technical, Management and Cost (TMC) Evaluation

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Outline

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Introduction: TMC Evaluation

The NASA Science Mission Directorate (SMD) Science Support Office (SSO) was established in 1996 by the Office of Space Science to support the Discovery and Explorer Programs, now also supports the New Frontiers, Mars Scout, Earth System Science Pathfinder (ESSP), Living With a Star (LWS) and Solar Terrestrial Probes (STP) programs, and others. The TMC process is a standard process used by SSO to support all SMD evaluations.

The TMC evaluation is to determine, for each Proposal, the level of risk of accomplishing the scientific objectives of the investigation, as proposed, on schedule and within cost.

There are three possible Risk Ratings: Low, Medium, and High

–**Low Risk:** There are no problems in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation.

–**Medium Risk:** Problems have been identified, but are considered within the proposal team's capabilities to correct with good management and application of effective engineering resources. Mission design may be complex and resources tight.

–**High Risk:** Problems are of sufficient magnitude such that failure is highly probable.

Introduction: SALMON

NASA pursues its strategic goals using a wide variety of space flight programs that enable remote sensing, in situ investigations, and exploration. These investigations are carried out through flight of space missions in Earth orbit, to the Moon, and to or beyond objects in the Solar System, as well as through ground-based research activities that directly support these space missions.

Stand Alone Missions of Opportunity Notice (SALMON) Announcement of Opportunity (AO) invites proposals for Missions of Opportunity (MO). A MO is a focused space flight investigation that offers high scientific or technical value for a modest cost to NASA. There are five categories of MO under this AO: Partner Missions of Opportunity (PMOs), U.S. Participating Investigators (USPIs), New Science Missions using Existing Spacecraft, Small Complete Missions (SCMs), and Focused Missions of Opportunity (FMOs).

- PMOs are investigations that provide a critical component of a non-NASA or non-US mission – such as a complete science instrument, hardware or software components, technology demonstrations, or microgravity research experiments.
- USPIs are complete science investigations that are realized through the participation of U.S. investigators on non-NASA missions and do not involve the development of hardware or software components or complete instruments or subsystems.
- New Science Missions using Existing Spacecraft are investigations that propose a scientific new use of existing NASA spacecraft.
- SCMs are scientifically or technically valuable investigations that can be realized within the specified cost cap, including the cost of their access to space if not provided by NASA.
- FMOs are investigations that address a specific, NASA-identified flight opportunity.

Further information on the five categories of MOs is provided in Section 5 of the AO.

Evaluation Criteria

The evaluation criteria (Section 7.2 of AO) for Proposed Investigations are:

- Scientific or technical merit of the proposed investigation (40%);
- Implementation merit and the feasibility of the proposed investigation (30%); &
- Technical, management, and cost feasibility, including cost risk (30%)

Standard evaluation factors for each of these criteria are described in the SALMON AO. Note that PEAs may specify additional evaluation factors for these three criteria.

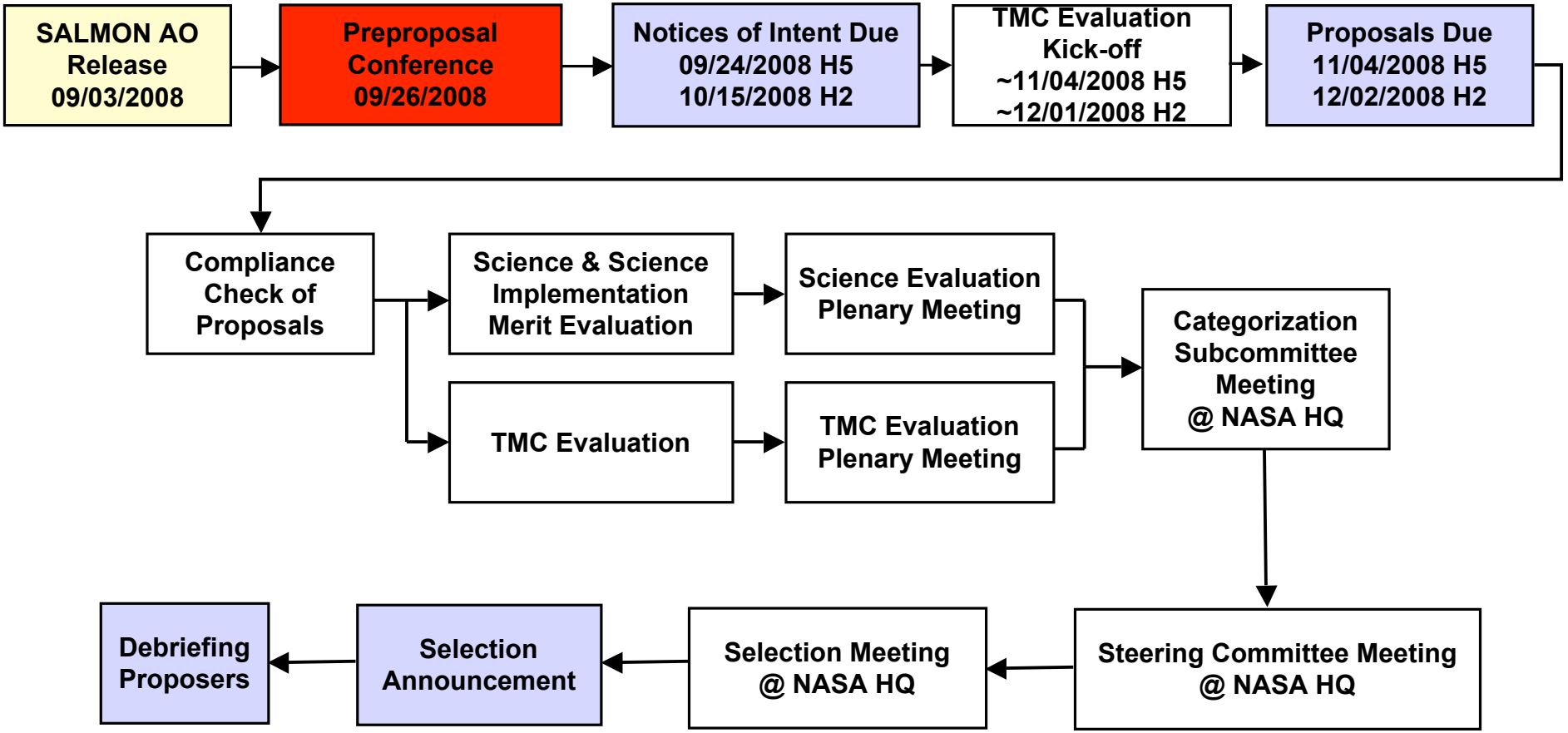
Additional Evaluation Factors

PEA H2 - **In addition** - the demonstrated scientific merit that this investigation's archived data adds to the Planetary Science community.

PEA H3 - For missions proposed to achieve a rendezvous with the Earth's Moon or another Solar System body, **in addition** - the demonstrated scientific merit that this investigation's archived data adds to the Planetary Science community.

Evaluation Criteria

Evaluation Flow for H2 and H5



Evaluation Criteria: TMC (Section 7.2.4 of AO)

Each proposed investigation will be evaluated for its technical, management, and cost feasibility, including cost risk, as expressed in terms of specific major and minor strengths and weaknesses. The technical and management approaches will be evaluated to assess the likelihood that the investigation can be implemented as proposed. This includes an assessment of risk of completing the investigation within the proposed schedule and cost. The evaluation will consider, as appropriate, implementation factors such as the overall mission design (i.e., "mission architecture"); spacecraft design and design margins; communication and navigation/tracking; and the proposers' understanding of the processes, products, and activities required to accomplish development and integration of all elements (flight systems, ground and data systems, etc.). This assessment will also consider the adequacy of the proposed organizational structure, the roles and experience of the known partners, the management approach, the commitments of partners and contributors, and the team's understanding of the scope of work (covering all elements of the mission, including contributions). The relationship of the work to the schedule, the mission's interdependencies, and associated schedule margins will also be evaluated. When appropriate, the likelihood of launching by the proposed launch date will be assessed. Since it is recognized that teaming arrangements for implementing the mission may not be complete before the proposal closing date, proposers will not be penalized if the proposal indicates only candidate (but credible) implementation approaches for the spacecraft, launch vehicle, communications, and ground systems that should reasonably allow successful implementation of the mission.

Mission resiliency (the flexibility to recover from problems) will also be evaluated. This will include an assessment of the approach to descope the Baseline Investigation in the event that development problems force reductions in scope. Investigations proposing new technology, i.e., technologies having a Technology Readiness Level (TRL) less than 6 (a *TRL Definitions* document may be found in the SALMON Reference Library), will be penalized for risk if adequate backup plans to ensure success of the investigations are not described.

Evaluation Criteria: TMC (Section 7.2.4 of AO)

The methods and rationale used to develop the estimated cost, and the discussion of cost risks, will be assessed. Proposals will be evaluated for the adequacy of the cost reserves; proposals with inadequate cost reserves, and those that do not demonstrate a thorough understanding of the cost risks, will be penalized. The single biggest item that reduces cost risk is a complete and detailed basis of estimate, including complete cost model input data, vendor quotes, comparisons to similar analogous investigations, etc.

The risk management approach the science investigation team intends to use will be assessed, as will any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities.

The role, qualifications, and experience of the PI will be assessed, as will the commitment, spaceflight experience, and past performance of the PI and his or her implementing institution, against the needs of the investigation. The role, qualifications, and experience of the PM (if assigned separately from the PI) will be assessed, as will the commitment and past performance of the PM and his or her implementing institution, against the needs of the investigation.

The plans for managing the risk of contributed critical goods and services will be assessed including the commitment of every partner as documented in letters of commitment and the adequacy of contingency plans for coping with the failure of a proposed cooperative arrangement.

For PMO investigations that fly on non-NASA missions, factors involving spacecraft and launch vehicle capabilities will be considered in the evaluation to assess the adequacy of mission resources in support of a successful PMO investigation (Section 5.2).

This evaluation will result in narrative text, as well as an appropriate adjectival rating.

SALMON AO Highlights

Phase E – Operations and Sustainment

Includes analysis and publication of data in the peer reviewed scientific and technical literature and delivery of the data to an appropriate NASA data archive.

As part of their funded Phase E activities, investigation teams shall include an appropriate period and funding resources for data analysis independent of archiving activities. The proposal shall explicitly demonstrate, analytically or otherwise, that sufficient resources have been allocated to ensure that data will be calibrated, analyzed, published, and archived within the proposed cost of the investigation.

SALMON AO Highlights

Space Operations, Navigation, and Communication (Section 4.5.2 of the AO)

As appropriate, mission operation requirements for SALMON investigations may include spacecraft command uplink and data downlink, radiometric tracking, mission control centers, orbit and attitude determination, and level-0 data processing. NASA Centers offer many services which may be available and cost-effective to proposers. Proposers are free to propose the use of services from sources other than those offered through NASA.

The NASA Space Communication and Navigation (SCaN) Program provides spacecraft tracking and radiometric data services through its three networks: the Near-Earth Network (NEN), the Deep Space Network (DSN), and the Space Network (SN). In addition, the NASA Integrated Services Network (NISN) can provide secure circuits from NASA Centers to mission and science operations centers located at universities and other non-NASA locations. Information on SCaN may be found at https://www.spacecomm.nasa.gov/spacecomm/.

Traditional spacecraft operations services such as command generation, telemetry processing, mission scheduling, orbit and attitude determination, spacecraft engineering data evaluation, and trending are also available through capabilities existing at Goddard Space Flight Center (GSFC) and JPL.

If required, costs for such services, whether obtained from NASA or other sources, shall be included in the mission cost estimate.

SALMON AO Highlights

Contributions of Critical Goods and Services (Section 4.6.6 of AO)

The proposal shall describe all contributions of critical goods and services, the risks of these contributions, and adequate contingency plans for coping with the failure of a proposed cooperative arrangement. The commitment of every partner, U.S. or non-U.S., offering a contribution shall be documented in letters of commitment (Section 4.6.7). For proposals offering contributions that are critical to the success of the proposed investigation, the evaluated risk will increase if the proposals: 1) do not have clear and simple technical and management interfaces in the proposed cooperative arrangements, 2) do not provide evidence in the proposal that the contribution is within the scientific and technical capability of the partner, or 3) do not have the required endorsement or a firm commitment to provide the offered contribution.

Requirements for Proposals Containing Non-U.S. Contributions (Section 4.8.6 of AO)

Proposals shall discuss mitigation plans, where possible, for the failure of funding or contributions to materialize when they are outside the control of the PI. Mitigation may include, but is not limited to, descoping the contributed items or holding reserves to develop the contribution directly. Reserves held for this purpose will be considered by NASA to be encumbered. When no mitigation is possible, this shall be explicitly acknowledged.

Non-U.S. contributions introduce schedule risk for implementing technical assistance agreements and international agreements. An adequate and realistic schedule shall be allocated for the execution of international agreements. Any proposed international participation shall be described at the same level of detail as that of U.S. partners, including the provision of cost, schedule, and management data. Failure to document cost and schedule data, management approaches, or failure to document the commitment of team members or funding agencies, may cause a proposal to be found unselectable.

SALMON AO Highlights

Cost Risk Management (Section 4.7.5 of the AO)

The proposal shall discuss the methods and of rationale (cost models, cost estimating relationships analogous missions, etc.) used to develop the estimated cost, and shall include a discussion of cost risks. Innovative cost effective features, processes, or approaches will be considered a strength if proven sound. However, even with innovative cost features, mission proposals that are unable to show an adequate unencumbered reserve are likely to be judged a high cost risk and not selected.

For the purpose of this AO, an adequate unencumbered reserve on the PI Mission Cost shall be measured against the cost to complete all Phases (A-F) of the mission. **A minimum 25% unencumbered cost reserve shall be required for Phase A through Phase D**. Minimum unencumbered cost reserves are not specified in this AO for Phases E and F; the PI shall establish and identify adequate reserves for these phases of the mission. The PI Mission Cost shall not increase from that offered in the proposal. The cost reserves shall not include funded schedule reserves. Minimum funded schedule reserves are not specified in this AO for any phase; the PI shall establish and identify adequate funded schedule reserves for all phases of the mission.

SALMON AO Highlights: Appendix B

- Appendix B provides instructions on what information must or should be provided.

- If this information is not provided as applicable, weaknesses may be noted in the evaluation.
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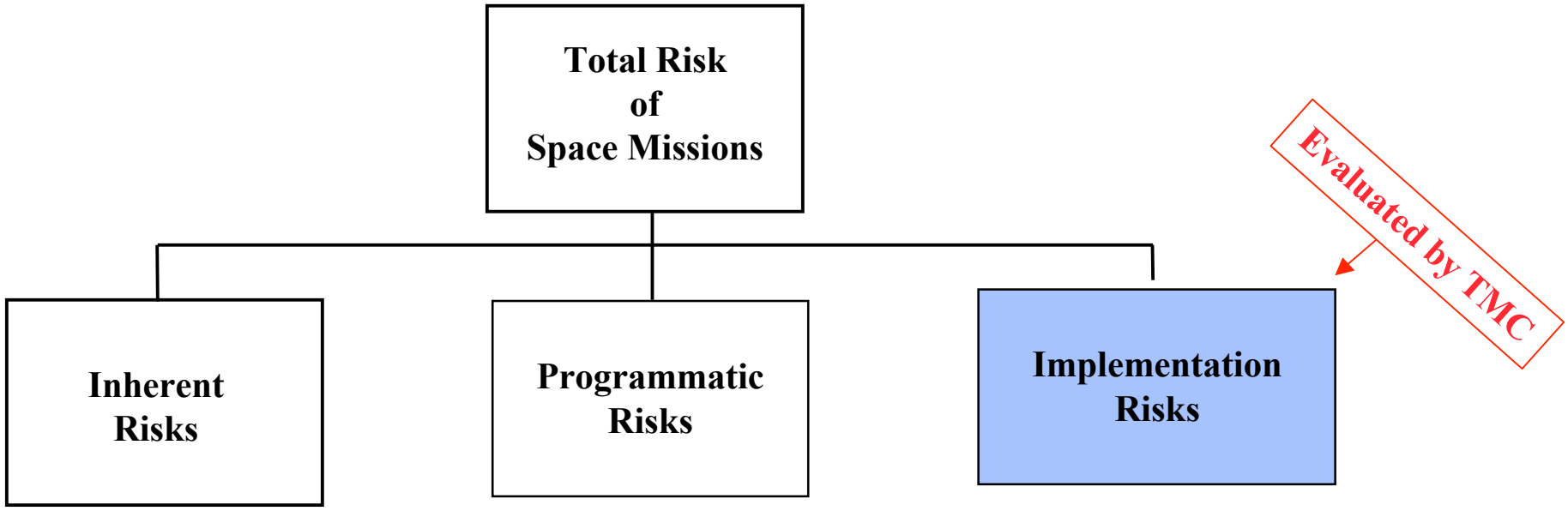
- Specific Topics areas with page limits are described in Table B.1 and Appendix B text.

- Proposals must provide the information requested in Appendix B and must be compliant with all constraints, guidelines and requirements in AO.

- If there is a conflict between AO and Appendix B and or Library documents, the AO takes precedence.

TMC Evaluation Process



Risks that are unavoidable to do the investigation:

- Launch environments
- Space environments
- Unknowns
- Etc.

Risks that are uncertainties due to matters beyond project control:

- Environmental Assessment approvals
- Budgetary uncertainties
- Political impacts
- Etc.

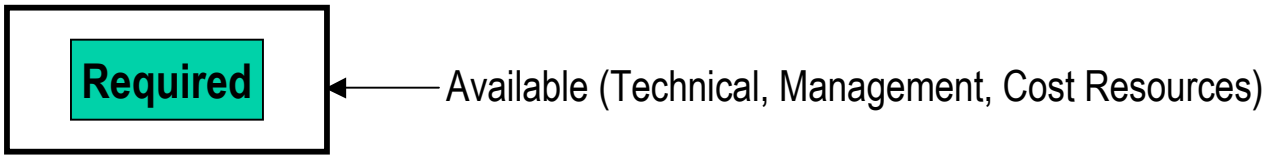
Risks that are associated with implementing the investigation:

- Adequacy of planning
- Adequacy of management
- Adequacy of development approach
- Adequacy of schedule
- Adequacy of funding
- Adequacy of Risk Management (planning for known & unknown)

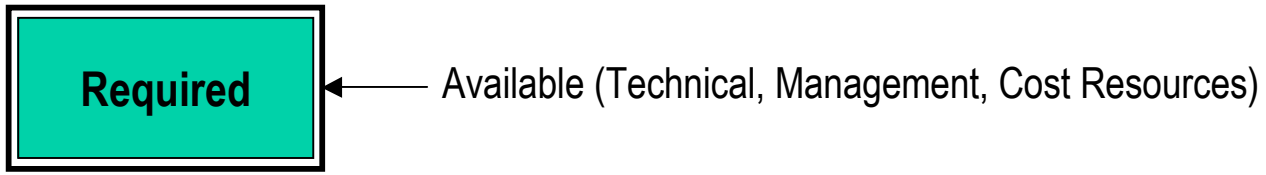
TMC Evaluation Process

TMC Envelope Concept: All TMC Resources available to handle known and unknown development problems that occur. Includes schedule and funding reserves; reserves and margins on physical resources such as mass, power, and data; descope options; fallback plans; and personnel.

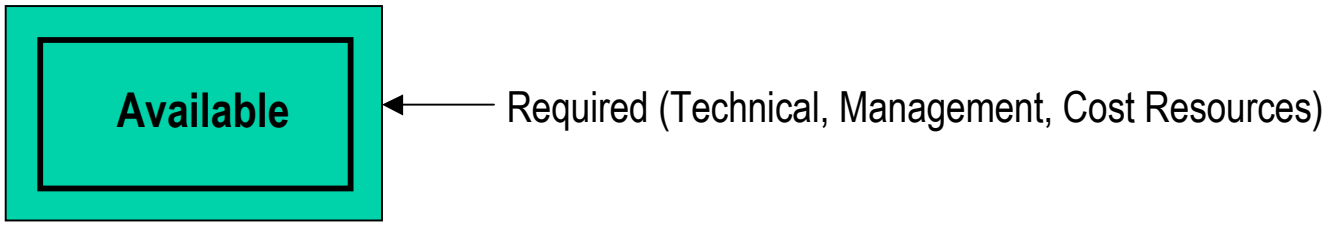
Low Risk: Required resources fit well within available resources

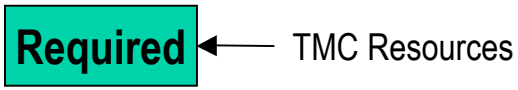


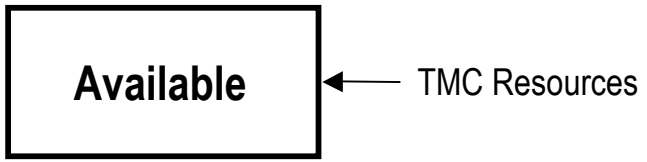
Medium Risk: Required resources just barely inside available resources. Tight, but likely doable



High Risk: Required resources DO NOT fit inside available resources. Expect project to fail







TMC Evaluation Process

Principles of the TMC Evaluation

- **Basic Assumption**: Proposer is the expert on his/her proposal.
  - **TMC:** Task is to try to validate proposer's assertion of Low Risk.
  - **Proposer:** Task is to provide evidence that the project is Low Risk.
  - Proposer given the benefit of the doubt in step one.

- **All Proposals will be reviewed to identical standards.**
  - All proposals receive same evaluation treatment in all areas.
  - Proposals are not compared to each other.

- **TMC Panel is made up of evaluators that are experts in the areas of the proposals that they evaluate.**

- **TMC Panel develops findings for each proposal that is the consensus of the entire TMC panel.**
  - Findings: As expected (no finding), above expectations (strengths), below expectations (weaknesses).
  - Only Major Strengths and Major Weaknesses are considered in determining the overall Risk rating.
- The final TMC evaluation product is an Evaluation Form.

TMC Evaluation Process

TMC Evaluation Factors and Sub-Factors

Generally, the degree to which Proposals address the following factors directly relates to the grade of Low, Medium, or High Risk:

- **Instrument**
  - Instrument Design
  - Design Heritage
  - Environment Concerns
  - Technology Readiness
  - Instrument Systems Engineering
- **Mission Design and Operations**
  - Mass Margins
  - Trajectory Analysis
  - Launch Services
  - Concept of Mission Operations
  - Ground Facilities – New/Existing
  - Telecommunications
- **Flight Systems**
  - Instrument Accommodations and Interface
  - Hardware/Software Design
  - Design Heritage
  - Spacecraft Systems Design
  - Design Margins (Excluding mass)
  - Qualification and Verification
  - Assembly, Test, and Launch Operations
  - Mission Assurance
  - Development of New Technology
- **Management and Schedule**
  - Roles and Responsibilities
  - Team Experience and Key Individuals Qualification
  - Project Management and Systems Engineering
  - Organizational Structure and Work Breakdown Structure (WBS)
  - International Participation
  - Risk Management, Including Descope Plan and Decision Milestones
  - Project-Level Schedule
  - Proposed Subcontracting Plans and SDB Participation.
- **Cost**
  - Basis of Estimate (BOE)
  - Cost Realism and Completeness
  - Cost Reserves by Phase
  - Comparison with TMC Estimates (Including Parametric Models/Analogies)

TMC Evaluation Process

Cost Evaluation

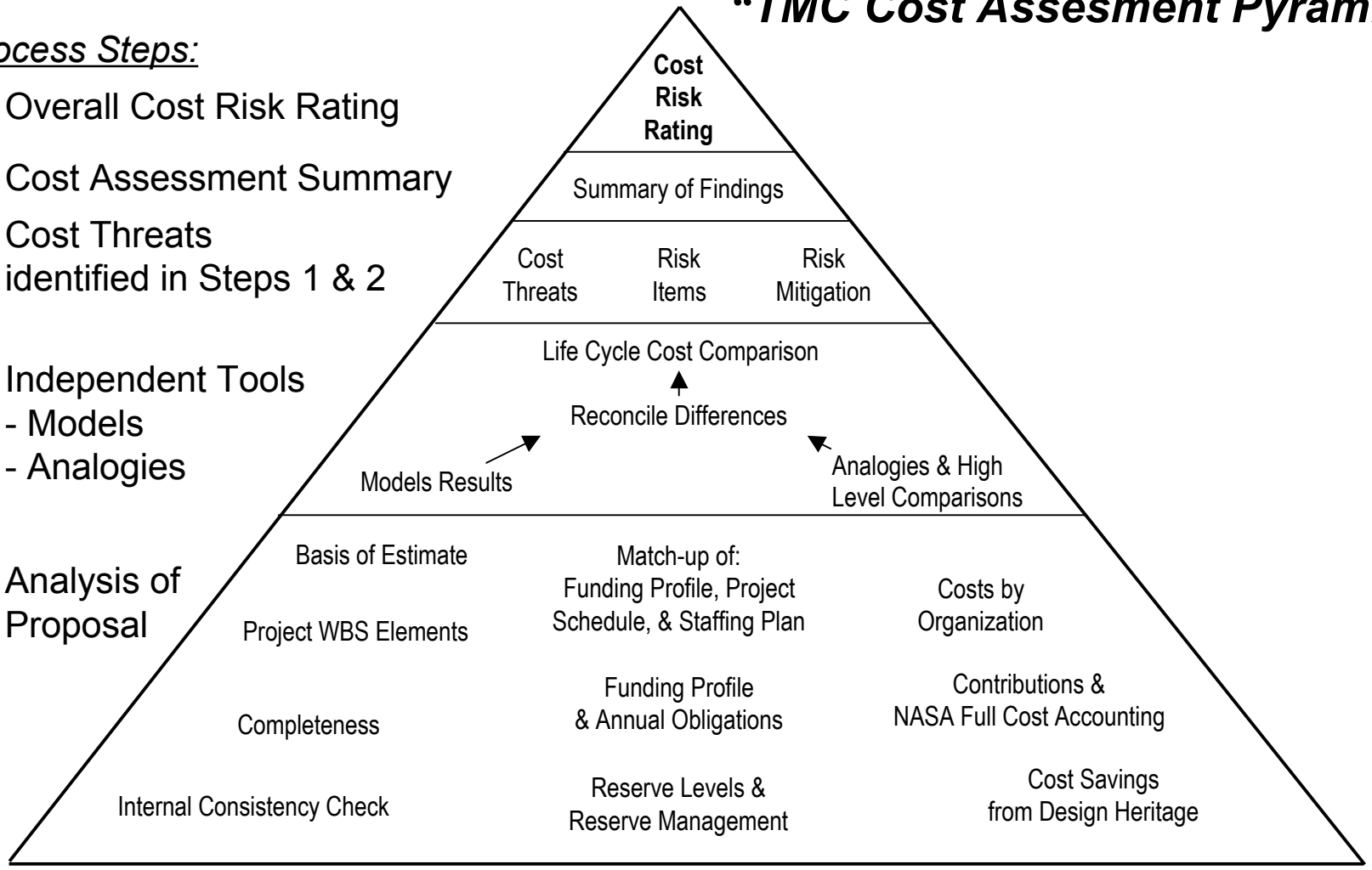
- Cost evaluation of Investigations will be accomplished using the same methodology.
- Cost analysis is accomplished based on information in the proposals (consistency, completeness, proposed basis of estimate, contributions, use of full cost accounting, maintenance of reserve levels, and cost management, etc.).
- Cost Realism is based on Models, Analogies, Heritage, and Grass Roots information in the proposals.
- Several independent cost models are used to analyze proposed cost.
- The cost threats, risks, and risk mitigation approach will be analyzed.
- Entire TMC Panel will participate in Cost deliberations and works to achieve consensus for Cost Risk.
- Cost Risk is reported in one of the following 5 categories: 1) Low Risk, 2) Medium-Low Risk, 3) Medium Risk, 4) Medium-High Risk, and 5) High Risk.
- The Cost Assessment and Cost Risk **are folded into the overall TMC Assessment and TMC Risk**.

TMC Evaluation Process

"TMC Cost Assesment Pyramid"

Process Steps:

5. Overall Cost Risk Rating
4. Cost Assessment Summary
3. Cost Threats identified in Steps 1 & 2
2. Independent Tools
   - Models
   - Analogies
1. Analysis of Proposal



TMC Evaluation Process

Typical TMC Evaluation Questions to be Answered

- Will overall investigation approach allow successful implementation as proposed?

  -If not, are there sufficient resources to correct identified problems?

- Does proposed design/development approach allow the investigation to have a reasonable probability of accomplishing its objectives and include all needed tools?
- Are requirements within existing capabilities or are advances required?
- Does the proposal accommodate sufficient resiliency in appropriate resources (e.g., money, mass, power) to accommodate development uncertainties?
- Is there a Risk Management approach adequate to identify problems with sufficient warning to allow for mitigation without impacting the investigation's objectives?
- Does the proposer understand the known risks and are there adequate fallback plans to mitigate them, including risk of using new developments, to assure that investigation can be completed as proposed?

TMC Evaluation Process

Typical TMC Evaluation Questions to be Answered (cont'd)

- Is the schedule doable?
- Does it reflect an understanding of work to be done and time it takes to do it?
- Is there a reasonable probability of delivering the investigation on time to meet Project Schedules?
- Does it include schedule margin?
- Will proposed management approach (e.g., institutions and personnel, as known, organization, roles and responsibilities, experience, commitment, performance measurement tools, decision process, etc) allow successful completion of investigation? Is the role, qualifications, and experience of the Management Team commensurate with the technical and managerial needs of the investigation?
- Does the investigation, as proposed, have a reasonable chance of being accomplished within proposed cost?
- Are proposed costs within appropriate caps and profiles and does cost estimate cover all costs including full-cost accounting for NASA Centers?
- Are costs phased reasonably?
- Is there evidence in the proposal to give confidence in the proposed cost?
- Does the proposer recognize all potential risks/threats for additional costs or cost growth (e.g., late deliveries of components)?

TMC Evaluation Process

Some Characteristics Applicable to a Low Risk Rating

- All risks for the project have been/are being identified and managed by the team, with plans to reduce or retire the risk before launch.
- There is either a workaround planned for all risks or a very sound plan to develop and qualify the risk item for flight.
- The proposed project team and each of its critical participants are competent, qualified, and committed to execute the project.
- The project will be self managed to a successful conclusion while providing reasonable visibility to NASA for oversight.
- The team has thoroughly analyzed all project requirements, and the resulting resources proposed are adequate to cover the projected needs, including an additional percentage for growth during the design and development, and additional margin for unforeseen difficulties.
- Reserve time is included in the schedule to find and fix problems that may arise.
- Any contributed assets for the project are backed by letters of commitment.
- The team understands the seriousness of failing to meet technical, schedule, or cost commitments for the project in today's environment.

TMC Evaluation Process

Lessons Learned

It is recommended reviewing causes of Major Weaknesses in paper on "Lessons Learned from Technical, Management, and Cost Review of Proposals"

It is also recommend reviewing the document "Predicting Mission Success in Small Satellite Missions"

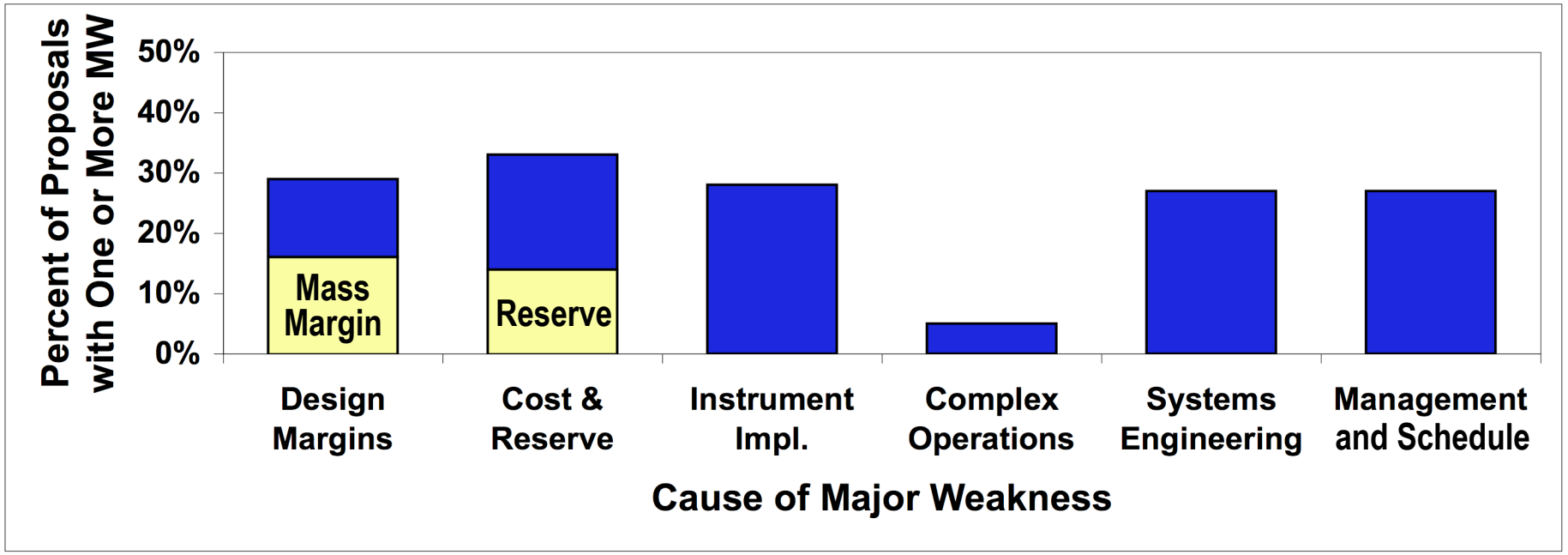
These documents are available on the SALMON Reference Library.

Lessons Learned from TMC Reviews

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Introduction

- Common causes for Major Weaknesses can be categorized in six areas noted below.
- The figure also shows the percentage of Step 1 proposals with one or more identified Major Weaknesses in each of these categories.
- Two issues, mass margin and cost reserve, are highlighted for special attention since they are prominent as sources of many Major Weakness findings.



Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Common Causes of Major Weaknesses (continued):

- Technical Design Margins (Mass, Power, etc.)
  - Insufficient data provided from which to independently verify the margins.
  - No margin provided or conflicting data provided.
  - Margin provided deemed too low based on the maturity of the design.
- Cost
  - Concerns relating to cost reserve (Below AO requirement, too low based on liens/threats, phasing inconsistent with anticipated needs).
  - Unable to validate proposed cost
- Instrument Implementation
  - Heritage claims not substantiated/development risks not adequately addressed.
  - Inadequate/inconsistent description and detail.
  - Inconsistencies between instrument requirements and bus capabilities.
- Complex Operations
  - More common in payloads containing multiple instrument that required tight scheduling/sequential operations.
  - Inadequately addressing the challenges inherent in lander operations.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Common Causes of Major Weaknesses (continued):

- Systems Engineering
  - Incomplete flow-down of science requirements to payload/flight system accommodations.
  - Incomplete description of how the systems engineering function will be executed.
  - Inadequate resources allocated to accomplish this function.
- Management Plans
  - Confusing/conflicting organizational roles and responsibilities.
  - Lack of demonstrated organizational/individual expertise for specified role.
  - Insufficient time commitments for key personnel.
- Schedules
  - Insufficient detail from which to perform an independent assessment.
  - Inadequate/no schedule reserve identified.
  - Overly ambitious schedules that are not consistent with recent experiences.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Mass and power margins were the most prevalent areas of concern:

Mass: Common reasons for Major Weaknesses:

1. Unable to verify the margin.
2. No mass margin was identified or the proposal contained conflicting statements.
3. Mass margins were too low based on the maturity of the proposed design, or required elements were omitted.
4. Confusion between mass contingency and mass margin.

Power: Common reasons for Major Weaknesses:

1. Margins were not calculated against the most critical or demanding operating mode.
2. Maneuver impulse budgets and propellant requirements could not be verified.
3. Could not verify and assess suitability of stated margins for both high-thrust and low-thrust propulsion systems.

The TMC review teams look for a competent engineering design that includes appropriate levels of contingency *and* margin, along with suitable rationale for the size of both.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Cost

There are three common reasons why proposals received a cost Major Weakness:

1. Cost Reserve is too low.
   - A reserve level (percent of cost-to-go) is below the stated AO requirement.
   - Liens already identified against the reserves.
   - Reserves are too low to cover cost threats identified during evaluation.
   - Phasing of reserves in the funding profile is too late to be useful.
2. Basis of Estimate is flawed: Rationale and method is unconvincing or deficient.
3. Unable to validate proposer's cost estimate:
   - Multiple independent cost analyses are developed for each proposal.
   - A large uncertainty bar is added giving the benefit of doubt to the proposer.
   - A proposed cost that falls outside this cost range is likely to be flagged as a Major Weakness.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Instrument Implementation

Areas of concern that produce Major Weaknesses include:

1. Complex new designs for which the development risks are not adequately addressed.
2. Inadequate or inconsistent description and detail that preclude a reasonable TMC evaluation.
3. Weak heritage claims.
4. Inconsistencies between instrument requirements and the spacecraft instrument accommodation capabilities.
5. Insufficient integration and test program including an end-to-end verification test.
6. Issues with pointing performance (knowledge, accuracy, etc.) and potential for detector contamination during flight.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Complex Operations

Major Weaknesses related to the complexity of the proposed operations included:

1. Complex observing sequences for instruments:
   - For payloads consisting of several instruments that must be operated sequentially.
   - Where many critical events must occur in a short period of time.
2. Proposed landers that present additional operational challenges that may not be adequately planned.
3. Concept of operations not clearly defined and inadequate or incomplete explanation of how the operations planning will be developed and tested.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Systems Engineering

Major Weaknesses for Systems Engineering seem to occur more often in earlier proposals. Recent experience seems to indicate an improvement in the number of Major Weaknesses in this area, perhaps in response to firm AO requirements for a traceability matrix to flow down science requirements to instruments, payload accommodations and flight systems.

More recent concerns that continue to produce Major Weaknesses in systems engineering are:

1. Incomplete or unconvincing plan for how systems engineering responsibilities will be executed across the entire project.
2. Implementation plan not providing for adequate resources for all participating organizations to successfully accomplish this function.
3. Underestimates of the cost of this function.

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Management and Schedule

The common causes of Major Weaknesses in project management are as follows.

1. Confusing organizational roles and responsibilities for the participating institutions or key individuals.
2. Unclear lines of authority within the project, or between the project and the participating institutions.
3. Lack of demonstrated organization or individual expertise for the specific role identified.
4. Low time commitments for essential members of the core management team.
5. Missing letters of commitment or endorsement from partners, as required by AO.

The common causes for Major Weakness in schedule are as follows:

1. Insufficient detail from which to perform a reasonable assessment of whether the proposer understands how all of the work will be accomplished in time.
2. The master schedule shows inadequate or no margin to address potential delays.
3. TMC assesses whether the proposed schedule reflects realistic expectations based on recent experiences in flight system and payload development. An area that receives special consideration is the plan for Assembly, Test, and Launch Operations (ATLO).

Lessons Learned from TMC Reviews: Common Causes of Major Weaknesses

Summary

- The results presented were derived from an analysis of all TMC proposal evaluation activity conducted by the SSO during the period 1996-2005.
- The TMC review team looks for evidence of thorough designs and robust plans in all aspects of the proposed technical, management, and cost considerations. The final judgment of how well the proposal meets this expectation is the Implementation Risk Rating, which is summarized as Low, Medium, or High Risk.
- The primary consideration that raises a proposal's Risk Rating from Low to Medium or High is the Major Weaknesses identified during the Step 1 proposal review. Not all Major Weaknesses are of equal importance: One serious issue may be enough to convince the TMC review team that Risk Rating is High.
- Review of the 10-year history of proposal evaluations conducted by the SSO identified six areas that are common causes of Major Weaknesses: 1) Design margins, 2) Cost issues, 3) Instrument implementation, 4) Complex operations, 5) Systems engineering, and 6) Management and Schedule Plans.

The goal of proposers should be to eliminate Major Weaknesses from their proposals.

Supplemental Information

TMC Key Technical Definitions

- **Contingency (or Reserve):** When added to a resource, results in the maximum expected value for that resource. Percent contingency is the proposed value of the contingency divided by the maximum expected value of the resource minus the contingency.

- **Margin:** The difference between the maximum possible value of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the margin divided by the maximum possible value minus the margin.

- **Example 1:** A payload in the design phase has an estimated mass of 115 kg including a proposed mass reserve of 15 kg. There is no other payload on the ELV and the ELV provider plans to allot the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass reserve is 15/100 = 15% and the mass margin is 85 kg or 85/115 = 74%

- **Example 2:** The end-of-mission life capability of a spacecraft power system is 200 watts. The proposed instrument is expected to use 40 watts, and a 25% contingency is planned. If 75 watts is allotted by the satellite provider, the reserve is 10 watts and the margin is 25 watts, or 25/50 = 50%